A SEARCH FOR C$_4$ AND C$_5$ IN THE (MOLECULAR) CARBON-RICH SIGHTLINE TOWARD HD 204827

M. ADAMKOVICS, Astronomy Department, 601 Campbell Hall, University of California, Berkeley, CA 94720; G. A. BLAKE, Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, CA 91125; B. J. McCALL, Departments of Chemistry and Astronomy, University of Illinois at Urbana-Champaign, 601 S. Mathews Ave., Urbana, IL 61801.

The simplest carbon-chain molecule C$_2$ was discovered in the interstellar medium in 1977. Fourteen years later, J. P. Maier and others reported the first detection of C$_3$ in three diffuse cloud sightlines. A followup survey at lower resolution detected C$_3$ in 15 lines of sight with E$_B$ - V ranging from 0.33 to 1.12 and noted that the sightline toward HD 204827 showed particularly high C$_2$ and C$_3$ column densities. This result was confirmed by a survey at higher resolution.

The next-longest carbon chains, C$_4$ and C$_5$, have not yet been detected in the interstellar medium. A low resolution search was performed by Oka et al., and a more sensitive high resolution search has been reported towards ζ Ophiuchi using the 3789 Å band of C$_4$ and the 5109 Å band of C$_5$. While ζ Ophiuchi is a very bright star (V=2.56), its C$_3$ column density ($1.5 \times 10^{13}$ cm$^{-2}$) is considerably lower than that towards HD 204827 ($1.15 \times 10^{13}$ cm$^{-2}$). Consequently, we decided to attempt a sensitive search for C$_4$ and C$_5$ in this carbon-rich sightline. The relative faintness (V=7.94) of the source was overcome by the large aperture (10-m) of the Keck telescope and a long (two nights) integration. Unfortunately, this work has not yielded a detection. A detailed interpretation of this non-detection in terms of carbon chain chemistry in diffuse clouds is hampered both by uncertainties in the oscillator strengths of the transitions as well as by the comparatively immature state of chemical models of diffuse cloud chemistry (relative to models of dense cloud chemistry). We encourage further theoretical and modelling efforts along these lines.

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